

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

STOOLE, Brian, David
Geco-Prakla (UK) Limited
Schlumberger House
Buckingham Gate
Gatwick, West Sussex RH6 0NZ
ROYAUME-UNI

Date of mailing (day/month/year)

21 February 2001 (21.02.01)

Applicant's or agent's file reference

14.0123

IMPORTANT NOTIFICATION

International application No.

PCT/IB99/01590

International filing date (day/month/year)

28 September 1999 (28.09.99)

1. The following indications appeared on record concerning:



the applicant



the inventor



the agent



the common representative

Name and Address

GECO AS
Schlumberger House
Solbraveien 23
N-1372 Asker
Norway

State of Nationality

NO

State of Residence

NO

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:



the person



the name



the address



the nationality



the residence

Name and Address

SCHLUMBERGER HOLDINGS LIMITED
P.O. Box 71
Craigmuir Chambers
Road Town
Tortola
Virgin Islands, British

State of Nationality

**

State of Residence

**

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:



the receiving Office



the International Searching Authority



the International Preliminary Examining Authority



the designated Offices concerned



the elected Offices concerned



other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Dominique DELMAS

Telephone No.: (41-22) 338.83.38

003852929

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

To: STOOLE, BRIAN DAVID GECO-PRAKLA (UK) Limited Schlumberger House Buckingham Gate Gatwick, West Sussex RH6 0NZ GRANDE BRETAGNE	PB <input type="checkbox"/> Progress <input type="checkbox"/> Index <input type="checkbox"/> Ace <input type="checkbox"/> MIS <input type="checkbox"/>	Abstract <input type="checkbox"/> Blue B/R <input type="checkbox"/> Renewal <input type="checkbox"/> <div style="text-align: center; font-size: 1.2em;">25 JAN 2001 133</div>
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Date of mailing (day/month/year)	23. 01. 01
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Applicant's or agent's file reference 14.0123	IMPORTANT NOTIFICATION	
International application No. PCT/IB99/01590	International filing date (day/month/year) 28/09/1999	Priority date (day/month/year) 01/10/1998
Applicant GECO AS et al.		

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/ <div style="display: flex; align-items: center;"> <div> European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 </div> </div>	Authorized officer De Caemel, J-M Tel. +49 89 2399-2557
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PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 14.0123	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB99/01590	International filing date (day/month/year) 28/09/1999	Priority date (day/month/year) 01/10/1998
International Patent Classification (IPC) or national classification and IPC G01V1/38		
Applicant GECO AS et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 24/03/2000	Date of completion of this report 23. m 07
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Juárez Colera, M Telephone No. +49 89 2399 2482 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01590

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-3,5-19	as originally filed			
4	as received on	16/10/2000	with letter of	09/10/2000

Claims, No.:

1-24	as received on	16/10/2000	with letter of	09/10/2000
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Drawings, sheets:

1/3-3/3	as originally filed
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2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB99/01590

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-24
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-24
Industrial applicability (IA)	Yes:	Claims	1-24
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Prior art

Reference is made to the following documents:

D1: EP-A-0 613 025 (GECO AS) 31 August 1994 (1994-08-31)

D2: US-A-4 676 183 (CONBOY MICHAEL R) 30 June 1987 (1987-06-30)

D3: US-A-4 890 568 (DOLENGOWSKI GEORGE A) 2 January 1990 (1990-01-02)

D4: WO 98 28636 A (BITTLESTON SIMON HASTINGS ;GECO AS (NO)) 2 July 1998 (1998-07-02) cited in the application

2 Article 33 (1) and (2) PCT (Novelty)

- 2.1 None of the available prior art documents discloses an apparatus or a method with the combination of features described in claims 1 and 15. The subject matter of these claims is therefore new.
- 2.2 Claims 2-14 and 16-24 are dependent on claims 1 and 15 respectively and as such also meet the requirements of the PCT with respect to novelty.

3 Article 33 (1) and (3) PCT (Inventive Step)

- 3.1 The present application does not meet the requirements of Article 33 (1) and (3) PCT, because the subject-matter of claims 1-24 does not involve an inventive step, the reasons being as follows:
- 3.2 The document D1 discloses (cf. abstract; col. 1, l. 1-6; col. 4, l. 5-15; col. 5, l. 7-9 and 33-40; col. 6, l. 38-45; col. 7, lines 17-20; col. 8, lines 21-36 and Figs. 4 and 5) a method and apparatus for controlling the positions of marine seismic streamers being towed by a vessel the streamers having a streamer positioning device having a first and a second wing (7) independently moveable and wing

motors (10, 23, 32) for changing the orientation of the wings so as to steer the positioning device laterally, the control made by obtaining an estimated position and velocity of the streamer positioning device, calculating a desired change in these position and velocity and actuating the motors to produce the desired change by applying a horizontal and a vertical force to the streamer through the streamer positioning device. The disclosed device also comprises global and a local control systems that communicate through a communication line passing through the streamer.

- 3.3 The subject-matter of method claim 1 and apparatus claim 15 differs from D1 in that there are several positioning devices disposed along the streamers.
- 3.4 The objective problem to be solved by the present invention may therefore be regarded as better controlling the lateral position of the streamers.
- 3.5 The solution proposed in claims 1 and 15 of the present application, consisting on placing several positioning devices along the streamers, cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
- 3.6 The fact of placing several positioning devices along the streamers for controlling their position from these several points is already known in the art as it is acknowledge by Fig 1 of the present application which represents the prior art (see also, as an example, document D3). The skilled person would therefore regard it as a normal design option to include birds of the type described in D1 into the normal pattern (Fig 1) in order to solve the problem posed, and thus arriving to the invention of claims 1 and 15. Consequently, the solution proposed by claims 1 and 15 cannot be regarded as involving an inventive step.
- 3.7 Taking into account the above paragraph 3.2, the features added by dependent claims 11, 12, 16 and 19 are also disclosed in D1. Accordingly, these claims also lack inventive step.
- 3.8 The features introduced by claims 6, 9, 10, 17 and 23 are disclosed in the documents D2 (col. 3, l. 67-68) , D3 (col.6, l. 61 - col. 7, l. 3) and D4 (pg. 5, l. 13-17 and pg. 7, l.9-14) as providing the same advantages as in the present

application. The combination of these documents with the document D1 would be obvious since all documents are concerned to the same subject-matter of controlling streamer positioning devices. The skilled person would therefore regard it as a normal design option to include these features in the method and device described in document D1, thus arriving to the subject matter of the above mentioned claims.

- 3.9 In the dependent claims 2-5, 7, 8, 13, 14, 16, 18 and 20-22 slight changes in the method of claim 1 and in the device of claim 15 are defined which come within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of these claims also lacks an inventive step.

4 Article 33 (1) and (4) PCT (Industrial Applicability)

The subject matter of claims 1-24 is susceptible of industrial application.

Re Item VII

Certain defects in the international application

- 1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.
- 2 Independent claims 1 and 15 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- 3 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

Article 6 PCT (Clarity)

- 1 Claims 7, 8, 16, 19 and 20 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined because of the following reasons:
- 2 Due to the use of the term "attempt" used in claims 7 and 8, the claims define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem.
- 3 The relative term "near" used in claims 7 and 19 has no well-recognised meaning and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear.
- 4 Furthermore, it is not clear from the formulation of claim 7 that the term "turn" refers to a turn of the vessel.
- 5 Claim 16 attempts to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.
- 6 Claim 19 seeks to define the invention by reference to a feature of the apparatus' use, the vessel not being part of the claimed device, thereby resulting in a lack of clarity, see PCT Guidelines IV-III-4.8a.
- 7 Finally, concerning claims 19 and 20 the following functional statements do not enable the skilled person to determine which technical features are necessary to perform the stated functions:
Claim 19: global and local control system communicating using a communication line, and
Claim 20: the program units being downloaded.

An advantage of the present invention is that the position of the streamer may be better controlled, thereby reducing the need for in-fill shooting, reducing the chance of streamer tangling, and reducing the time needed to turn the seismic survey vessel.

Another advantage of the present invention is that noise in marine seismic data associated with streamer position over-correction and streamer positioning errors can be significantly reduced.

SUMMARY OF THE INVENTION

The present invention provides methods and apparatus for controlling the positions of marine seismic streamers in an array of such streamers being towed by a seismic survey vessel, the streamers having respective streamer positioning devices disposed therealong and each streamer positioning device having a wing and a wing motor for changing the orientation of the wing so as to steer the streamer positioning device laterally, said methods and apparatus involving (a) obtaining an estimated velocity of the streamer positioning devices, (b) for at least some of the streamer positioning devices, calculating desired changes in the orientation of their wings using said estimated velocity, and (c) actuating the wing motors to produce said desired changes in wing orientation.

The invention and its benefits will be better understood with reference to the detailed description below and the accompanying figures.

CLAIMS

1. A method of controlling the positions of marine seismic streamers in an array of such streamers being towed by a seismic survey vessel, the streamers having respective streamer positioning devices disposed therealong and each streamer positioning device having a wing and a wing motor for changing the orientation of the wing so as to steer the streamer positioning device laterally, said method comprising the steps of:
 - obtaining an estimated velocity of the streamer positioning devices;
 - for at least some of the streamer positioning devices, calculating desired changes in the orientation of their wings using said estimated velocity; and
 - actuating the wing motors to produce said desired changes in wing orientation.
2. A method as claimed in claim 1, wherein said estimated velocity is calculated using a vessel speed received from said seismic survey vessel's navigation system.
3. A method as claimed in claim 1 or claim 2, in which said estimated velocity is a water referenced towing velocity that compensates for the speed and heading of marine currents acting on said streamer positioning devices.
4. A method as claimed in any one of the previous claims, in which said estimated velocity is compensated for relative movement between said seismic survey vessel and said streamer positioning devices.
5. A method as claimed in any one of the previous claims, in which said step of calculating a desired change in wing orientation further uses an estimate of the crosscurrent velocity at the respective streamer positioning device.

6. A method as claimed in any one of the previous claims, in which said step of calculating a desired change in wing orientation is regulated to prevent the wing from stalling.

7. A method as claimed in any one of the previous claims, in which said step of calculating a desired change in wing orientation is regulated by a global control system located on or near said seismic survey vessel that may be configured into a feather angle mode, wherein said global control system attempts to direct the streamer positioning devices to maintain each of said streamers in a straight line offset from the towing direction of said marine seismic vessel by a certain feather angle, and into a turn control mode, wherein said global control system directs said streamer positioning devices to generate a force in the opposite direction of the turn at the beginning of the turn.

8. A method as claimed in claim 7, in which said global control system may further be configured into a streamer separation mode, wherein said global control system attempts to direct said streamer positioning device to maintain a minimum separation distance between adjacent streamers.

9. A method as claimed in any one of the previous claims, further including the step of displaying the position of said streamer positioning devices on said seismic survey vessel.

10. A method as claimed in any one of the previous claims, in which each streamer positioning device is attached to and unable rotate with respect to its streamer and further comprising the step of monitoring twist in said marine seismic streamers and calculating a desired change in the orientation of the wings of the streamer positioning devices to reduce said twist.

11. A method as claimed in any one of the previous claims, further including the step of obtaining estimates of the respective current positions of

at least some of said streamer positioning devices and the step of obtaining the desired positions of each of said at least some streamer positioning devices.

12. A method as claimed in claim 11, wherein the estimate of the current position of a streamer positioning device and the desired position of that same streamer positioning device are used to produce a desired force to be applied to its streamer by that streamer positioning device.

13. A method as claimed in claim 12, in which said desired force is projected onto the current force axis and the wing orientation is calculated that will produce said projected force at said estimated velocity.

14. A method as claimed in claim 13, in which the streamer positioning device is rotated to align the current force axis with said desired force and its wing orientation is changed as the current force axis becomes more closely aligned with said desired force.

15. Apparatus for controlling the positions of marine seismic streamers in an array of such streamers being towed by a seismic survey vessel, the streamers having respective streamer positioning devices disposed therealong and each streamer positioning device having a wing and a wing motor for changing the horizontal orientation of the wing so as to steer the streamer positioning device laterally, said apparatus comprising:

means for obtaining an estimated velocity of the streamer positioning devices,

means for calculating desired changes in the orientations of the respective wings of at least some of the streamer positioning devices using said estimated velocity; and

means for actuating the wing motors to produce said desired changes in wing orientation.

16. Apparatus as claimed in claim 15, in which each streamer positioning device has a first wing and a second wing, said first wing and said second wing being independently moveable to steer the streamer positioning device laterally and vertically.

17. Apparatus as claimed in claims 15 or claim 16, wherein each streamer positioning device is rigidly attached to and unable to rotate with respect to its streamer.

18. Apparatus as claimed in any one of claims 15 to 17, further including means for determining the angular velocity of each streamer positioning device.

19. Apparatus as claimed in any one of claims 15 to 18, wherein a global control system is located on or near said seismic vessel and a respective local control system is located within or near each streamer positioning device and said global control system and said local control systems communicate using a respective communication line passing through each streamer.

20. Apparatus as claimed in claim 19, in which program units for said local control systems may be downloaded over said communication lines.

21. Apparatus as claimed in claim 19 or claim 20, further including a respective backup communications channel in each streamer between the global control system and the local control systems of the streamer positioning devices of the streamer.

22. Apparatus as claimed in any one of claims 19 to 21, in which each local control system has a cycle rate that is at least 10 times greater than the data transfer rate of said communication line.

23. Apparatus as claimed in any one of claims 19 to 22, in which each local control system comprises a microprocessor programmed to monitor the current orientation of the wing of its streamer positioning device and to calculate desired changes to the orientation of said wing based on inputs from said global control system.

24. Apparatus as claimed in any one of claims 15 to 23, further including means for producing a weightfunction filtered depth value.

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 14.0123	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/IB 99/01590	International filing date (day/month/year) 28/09/1999	(Earliest) Priority Date (day/month/year) 01/10/1998
Applicant GECO AS et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

CONTROL SYSTEM FOR POSITIONING OF MARINE SEISMIC STREAMERS

5. With regard to the **abstract**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☒ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The abstract is modified as follows:

line 1: after "positioning device" insert "(18)";
line 2: after "seismic streamer " insert "(12)";
line 2: after "survey vessel" insert "(10)".

INTERNATIONAL SEARCH REPORT

International Application No

/IB 99/01590

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 G01V1/38 B63B21/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01V B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 613 025 A (GECO AS) 31 August 1994 (1994-08-31)	1, 11, 12, 15, 16, 19
Y	page 2, column 1, line 1 - line 4 page 3, column 3, line 14 - line 23 page 3, column 3, line 44 - line 50 page 4, column 5, line 17 - line 35 page 4, column 6, line 38 - line 45; claims 1, 10, 11	6, 9, 17, 23
Y	US 4 676 183 A (CONBOY MICHAEL R) 30 June 1987 (1987-06-30) column 3, line 51 - column 4, line 2	6
Y	US 4 890 568 A (DOLENGOWSKI GEORGE A) 2 January 1990 (1990-01-02) column 1, line 5 - line 10 column 6, line 61 - column 7, line 3	9
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

20 December 1999

Date of mailing of the international search report

12/01/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Lorne, B

INTERNATIONAL SEARCH REPORT

International Application No

/IB 99/01590

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 28636 A (BITTLESTON SIMON HASTINGS ;GECO AS (NO)) 2 July 1998 (1998-07-02) cited in the application page 2, line 21 - line 29 page 4, line 7 - line 15 page 5, line 11 - line 24 page 6, line 1 - line 10 page 7, line 8 - line 13; claim 1 ---	17,23
A	US 4 729 333 A (KIRBY ROBERT A ET AL) 8 March 1988 (1988-03-08) column 3, line 11 - line 32 column 4, line 30 - line 40 column 7, line 20 - line 33 column 7, line 66 -column 8, line 19; claim 1 ---	1,15
A	GB 2 122 562 A (SEISMOGRAPH SERVICE) 18 January 1984 (1984-01-18) page 1, column 1, line 58 -column 2, line 90 page 2, column 1, line 18 - line 31 -----	1,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

/IB 99/01590

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0613025	A	31-08-1994	NO 930641 A	24-08-1994
			AU 678194 B	22-05-1997
			AU 5528094 A	01-09-1994
			US 5532975 A	02-07-1996
US 4676183	A	30-06-1987	CA 1283812 A	07-05-1991
			EP 0242483 A	28-10-1987
			NO 864721 A,B,	19-10-1987
US 4890568	A	02-01-1990	NONE	
WO 9828636	A	02-07-1998	AU 5330598 A	17-07-1998
			EP 0939910 A	08-09-1999
			GB 2331971 A,B	09-06-1999
			NO 992701 A	03-06-1999
US 4729333	A	08-03-1988	GB 2193476 A,B	10-02-1988
			NO 174616 B	28-02-1994
GB 2122562	A	18-01-1984	NO 832339 A	29-12-1983

15

PATENT COOPERATION TREATY
PCT

REC'D 25 JAN 2001

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PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 14.0123	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB99/01590	International filing date (day/month/year) 28/09/1999	Priority date (day/month/year) 01/10/1998
International Patent Classification (IPC) or national classification and IPC G01V1/38		
Applicant GECO AS et al.		



1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 24/03/2000	Date of completion of this report 23. 01. 01
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Juárez Colera, M Telephone No. +49 89 2399 2482 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01590

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-3,5-19	as originally filed			
4	as received on	16/10/2000	with letter of	09/10/2000

Claims, No.:

1-24	as received on	16/10/2000	with letter of	09/10/2000
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Drawings, sheets:

1/3-3/3	as originally filed
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2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB99/01590

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-24
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-24
Industrial applicability (IA)	Yes:	Claims	1-24
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Prior art

Reference is made to the following documents:

D1: EP-A-0 613 025 (GECO AS) 31 August 1994 (1994-08-31)

D2: US-A-4 676 183 (CONBOY MICHAEL R) 30 June 1987 (1987-06-30)

D3: US-A-4 890 568 (DOLENGOWSKI GEORGE A) 2 January 1990 (1990-01-02)

D4: WO 98 28636 A (BITTLESTON SIMON HASTINGS ;GECO AS (NO)) 2 July 1998 (1998-07-02) cited in the application

2 Article 33 (1) and (2) PCT (Novelty)

- 2.1 None of the available prior art documents discloses an apparatus or a method with the combination of features described in claims 1 and 15. The subject matter of these claims is therefore new.
- 2.2 Claims 2-14 and 16-24 are dependent on claims 1 and 15 respectively and as such also meet the requirements of the PCT with respect to novelty.

3 Article 33 (1) and (3) PCT (Inventive Step)

- 3.1 The present application does not meet the requirements of Article 33 (1) and (3) PCT, because the subject-matter of claims 1-24 does not involve an inventive step, the reasons being as follows:
- 3.2 The document D1 discloses (cf. abstract; col. 1, l. 1-6; col. 4, l. 5-15; col. 5, l. 7-9 and 33-40; col. 6, l. 38-45; col. 7, lines 17-20; col. 8, lines 21-36 and Figs. 4 and 5) a method and apparatus for controlling the positions of marine seismic streamers being towed by a vessel the streamers having a streamer positioning device having a first and a second wing (7) independently moveable and wing

motors (10, 23, 32) for changing the orientation of the wings so as to steer the positioning device laterally, the control made by obtaining an estimated position and velocity of the streamer positioning device, calculating a desired change in these position and velocity and actuating the motors to produce the desired change by applying a horizontal and a vertical force to the streamer through the streamer positioning device. The disclosed device also comprises global and a local control systems that communicate through a communication line passing through the streamer.

- 3.3 The subject-matter of method claim 1 and apparatus claim 15 differs from D1 in that there are several positioning devices disposed along the streamers.
- 3.4 The objective problem to be solved by the present invention may therefore be regarded as better controlling the lateral position of the streamers.
- 3.5 The solution proposed in claims 1 and 15 of the present application, consisting on placing several positioning devices along the streamers, cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
- 3.6 The fact of placing several positioning devices along the streamers for controlling their position from these several points is already known in the art as it is acknowledged by Fig 1 of the present application which represents the prior art (see also, as an example, document D3). The skilled person would therefore regard it as a normal design option to include birds of the type described in D1 into the normal pattern (Fig 1) in order to solve the problem posed, and thus arriving to the invention of claims 1 and 15. Consequently, the solution proposed by claims 1 and 15 cannot be regarded as involving an inventive step.
- 3.7 Taking into account the above paragraph 3.2, the features added by dependent claims 11, 12, 16 and 19 are also disclosed in D1. Accordingly, these claims also lack inventive step.
- 3.8 The features introduced by claims 6, 9, 10, 17 and 23 are disclosed in the documents D2 (col. 3, l. 67-68) , D3 (col.6, l. 61 - col. 7, l. 3) and D4 (pg. 5, l. 13-17 and pg. 7, l.9-14) as providing the same advantages as in the present

application. The combination of these documents with the document D1 would be obvious since all documents are concerned to the same subject-matter of controlling streamer positioning devices. The skilled person would therefore regard it as a normal design option to include these features in the method and device described in document D1, thus arriving to the subject matter of the above mentioned claims.

- 3.9 In the dependent claims 2-5, 7, 8, 13, 14, 16, 18 and 20-22 slight changes in the method of claim 1 and in the device of claim 15 are defined which come within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of these claims also lacks an inventive step.

4 Article 33 (1) and (4) PCT (Industrial Applicability)

The subject matter of claims 1-24 is susceptible of industrial application.

Re Item VII

Certain defects in the international application

- 1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.
- 2 Independent claims 1 and 15 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- 3 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

Article 6 PCT (Clarity)

- 1 Claims 7, 8, 16, 19 and 20 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined because of the following reasons:
- 2 Due to the use of the term "attempt" used in claims 7 and 8, the claims define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem.
- 3 The relative term "near" used in claims 7 and 19 has no well-recognised meaning and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear.
- 4 Furthermore, it is not clear from the formulation of claim 7 that the term "turn" refers to a turn of the vessel.
- 5 Claim 16 attempts to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.
- 6 Claim 19 seeks to define the invention by reference to a feature of the apparatus' use, the vessel not being part of the claimed device, thereby resulting in a lack of clarity, see PCT Guidelines IV-III-4.8a.
- 7 Finally, concerning claims 19 and 20 the following functional statements do not enable the skilled person to determine which technical features are necessary to perform the stated functions:
Claim 19: global and local control system communicating using a communication line, and
Claim 20: the program units being downloaded.

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ART 34 AMDT

An advantage of the present invention is that the position of the streamer may be better controlled, thereby reducing the need for in-fill shooting, reducing the chance of streamer tangling, and reducing the time needed to turn the seismic survey vessel.

Another advantage of the present invention is that noise in marine seismic data associated with streamer position over-correction and streamer positioning errors can be significantly reduced.

SUMMARY OF THE INVENTION

The present invention involves a method of controlling a streamer positioning device configured to be attached to a marine seismic streamer and towed by a seismic survey vessel and having a wing and a wing motor for changing the orientation of the wing. The method includes the steps of: obtaining an estimated velocity of the streamer positioning device, calculating a desired change in the orientation of the wing using the estimated velocity of the streamer positioning device, and actuating the wing motor to produce the desired change in the orientation of the wing. The present invention also involves an apparatus for controlling a streamer positioning device. The apparatus includes means for obtaining an estimated velocity of the streamer positioning device, means for calculating a desired change in the orientation of the wing using the estimated velocity of the streamer positioning device, and means for actuating the wing motor to effectuate the desired change in the orientation of the wing. The invention and its benefits will be better understood with reference to the detailed description below and the accompanying figures.

CLAIMS:

1. A method of controlling a streamer positioning device configured to be attached to a marine seismic streamer and towed by a seismic survey vessel and having a wing and a wing motor for changing the orientation of said wing, said method comprising the steps of:

obtaining an estimated velocity of said streamer positioning device,

calculating a desired change in the orientation of said wing using said estimated velocity of said streamer positioning device; and

actuating said wing motor to produce said desired change in said orientation of said wing.

2. A method as claimed in Claim 1, wherein said estimated velocity is calculated using a vessel speed received from said seismic survey vessel's navigation system.

3. A method as claimed in any one of the previous claims, in which said estimated velocity is a water referenced towing velocity that compensates for the speed and heading of marine currents acting on said streamer positioning device.

4. A method as claimed in any one of the previous claims, in which said estimated velocity is compensated for relative movement between said seismic survey vessel and said streamer positioning device.

5. A method as claimed in any one of the previous claims, in which said step of calculating a desired change in the orientation of said wing further uses an estimate of the crosscurrent velocity at said streamer positioning device.

6. A method as claimed in any one of the previous claims, in which said step of calculating a desired change in the orientation of said wing is regulated to prevent said wing from stalling.
7. A method as claimed in any one of the previous claims, in which said step of calculating a desired change in the orientation of said wing is regulated by a global control system located on or near said seismic survey vessel that may be configured into a feather angle mode, wherein said global control system attempts to direct said streamer positioning device to maintain said marine seismic streamer in a straight line offset from the towing direction of said marine seismic vessel by a certain feather angle, and into a turn control mode, wherein said global control system directs said streamer positioning device to generate a force in the opposite direction of the turn at the beginning of the turn.
8. A method as claimed in Claim 7, in which said global control system may further be configured into a streamer separation mode, wherein said global control system attempts to direct said streamer positioning device to maintain a minimum separation distance between adjacent marine seismic streamers being towed by said seismic survey vessel.
9. A method as claimed in any one of the previous claims, further including the step of displaying the position of said streamer positioning device on said seismic survey vessel.
10. A method as claimed in any one of the previous claims, in which said streamer positioning device is attached to and unable rotate with respect to said marine seismic streamer and further comprising the step of monitoring twist in said marine seismic streamer and calculating a desired change in the orientation of said wing to reduce said twist.

11. A method as claimed in any one of the previous claims, further including the step of obtaining an estimate of the current position of said streamer positioning device and the step of obtaining the desired position of said streamer positioning device.

12. A method as claimed in Claim 11, wherein said estimate of the current position of said positioning device and said desired position of said positioning device are used to produce a desired force to be applied to said streamer by said streamer positioning device.

13. A method as claimed in Claim 12, in which said desired force is projected onto the current force axis and the wing orientation is calculated that will produce said projected force at said estimated velocity.

14. A method as claimed in Claim 13, in which the streamer positioning device is rotated to align the current force axis with said desired force and said wing orientation is changed as the current force axis becomes more closely aligned with said desired force.

15. An apparatus for controlling a streamer positioning device configured to be attached to a marine seismic streamer and towed by a seismic survey vessel and having a wing and a wing motor for changing the horizontal orientation of said wing, said apparatus comprising:

means for obtaining an estimated velocity of said streamer positioning device,

means for calculating a desired change in the orientation of said wing using said estimated velocity of said streamer positioning device; and

means for actuating said wing motor to produce said desired change in said orientation of said wing.

16. An apparatus as claimed in Claim 15, in which said wing is a first wing and said streamer positioning device further has a second wing, said first wing and said second wing being independently moveable.

17. An apparatus as claimed in any one of Claims 15 or 16, wherein said streamer positioning device is rigidly attached to and unable to rotate with respect to said marine seismic streamer.

18. An apparatus as claimed in any one of Claims 15 to 17, further including means for determining the angular velocity of said streamer positioning device.

19. An apparatus as claimed in any one of Claims 15 to 18, wherein a global control system is located on or near said seismic vessel and a local control system is located within or near said streamer positioning device and said global control system and said local control system communicate using a communication line passing through said marine seismic streamer.

20. An apparatus as claimed in Claim 19, in which program units for said local control system may be downloaded over said communication line.

21. An apparatus as claimed in either Claim 19 or 20, further including a backup communications channel between and said global control system and said local control system.
22. An apparatus as claimed in any one of Claims 19 to 21, in which said local control system has a cycle rate that is at least 10 times greater than the data transfer rate of said communication line.
23. An apparatus as claimed in any one of Claims 19 to 22, in which said local control system comprises a microprocessor programmed to monitor the current orientation of said wing and to calculate desired changes to the orientation of said wing based on inputs from said global control system.
24. An apparatus as claimed in any one of Claims 15 to 23, further including means for producing a weightfunction filtered depth value.

U.S. INTERNATIONAL STAGE WORKSHEET (DO/EO)

U.S. APPL. NO. 09/787723 INTERNATIONAL APPL. 02899/01590

APPLICATION FILED BY: 20 MOS., _____ OR 30 MOS., ☒ SCREENED BY _____

Barbara Campbell
National Stage Processing
(703) 305-3631

INTERNATIONAL APPLICATION PAPERS IN THE APPLICATION FILE:

- ☐ International application
- ☐ Article 19 amendments
- ☐ Priority Document(s) No. _____
- ☐ Request Form PCT/RO/101
- ☐ PCT/IB/302
- ☐ PCT/IB/304
- ☒ PCT/IB/306
- ☐ PCT/IB/308
- ☐ PCT/IB/331
- ☐ OTHER PCT/IB/ _____
- ☒ PCT/IPEA/409 also 416

- ☒ 409 annexes to IPER
- ☒ PCT/ISA/210 (Search report)
- ☒ Search report References
- ☐ Other Papers filed

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 PUBLICATION DATE _____
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RECEIVED FROM THE APPLICANT: (other than checked above)

- ☒ National application basic fee paid
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- ☐ Translation of the International Application
- ☐ Used the IB copy of the IA
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- ☒ Claims
- ☒ Drawings
- ☐ Foreign Language in drawing
- ☐ Article 19 Amendments
- ☐ Amendment used in application
- ☒ Article 34 Amendment
- ☒ Amendment used in application
- ☐ DNA
- ☐ 1194 transaction done

- ☒ Preliminary Amendment(s) filed 3/21/01
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- ☒ Oath/Declaration (date submitted 3/21/01)
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35 USC Receipt of Request (PTO - 1399 Transmittal Letter) 3/21/01

Date Acceptable oath/declaration received 7/3/01

102(e) Date _____

Date complete 35 USC 371 requirements met _____

DATE NOTICE COMPLETED

DO/EO 903 Notice of Acceptance 7/10/01

DO/EO 905 Notice of Missing Requirements 4/29/01

DO/EO 917 Notice of A defective oath or declaration 4/29/01

DO/EO 916 Notice of defective response _____

DO/EO 913 Notice of defective translation _____

DO/EO 909 Notification of Abandonment _____

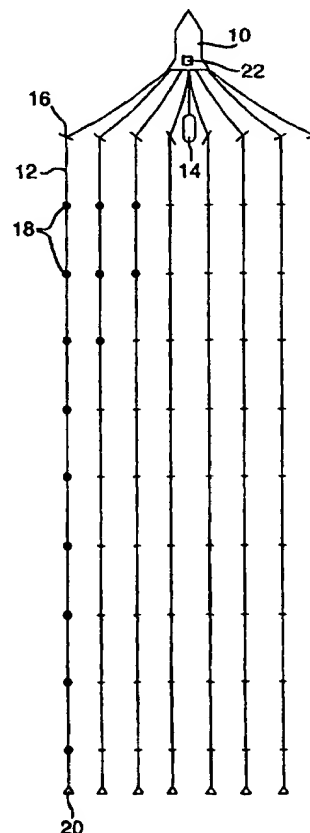


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : G01V 1/38, B63B 21/66	A1	(11) International Publication Number: WO 00/20895 (43) International Publication Date: 13 April 2000 (13.04.00)
(21) International Application Number: PCT/IB99/01590 (22) International Filing Date: 28 September 1999 (28.09.99) (30) Priority Data: 9821277.2 1 October 1998 (01.10.98) GB (71) Applicant (for all designated States except CA FR US): GECO AS [NO/NO]; Schlumberger House, Solbraveien 23, N-1372 Asker (NO). (71) Applicant (for CA only): SCHLUMBERGER CANADA LIMITED [CA/CA]; 24th floor, Monenco Place, 801 6th Avenue, SW, Calgary, Alberta T2P 3W2 (CA). (71) Applicant (for FR only): SERVICES PETROLIERS SCHLUMBERGER [FR/FR]; 42, rue Saint Dominique, F-75007 Paris (FR). (72) Inventors; and (75) Inventors/Applicants (for US only): <u>HILLESUND</u> , Oyvind [NO/NO]; Juterudaasen 47A, N-1312 Slependen (NO). <u>BIT-LESTON</u> , Simon, Hastings [GB/GB]; Weathercock Hill House, Weathercock Hill, Cheivington, Bury St Edmunds, Suffolk IP29 5GR (GB).		(74) Agent: STOOLE, Brian, David; Geco-Prakla (UK) Limited, Schlumberger House, Buckingham Gate, Gatwick, West Sussex RH6 0NZ (GB). (81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>

(54) Title: CONTROL SYSTEM FOR POSITIONING OF MARINE SEISMIC STREAMERS**(57) Abstract**

A method of controlling a streamer positioning device (18) configured to be attached to a marine seismic streamer (12) and towed by a seismic survey vessel (10) and having a wing and a wing motor for changing the orientation of the wing. The method includes the steps of: obtaining an estimated velocity of the streamer positioning device, calculating a desired change in the orientation of the wing using the estimated velocity of the streamer positioning device, and actuating the wing motor to produce the desired change in the orientation of the wing. The invention also involves an apparatus for controlling a streamer positioning device including means for obtaining an estimated velocity of the streamer positioning device, means for calculating a desired change in the orientation of the wing using the estimated velocity of the streamer positioning device, and means for actuating the wing motor to produce the desired change in the orientation of the wing.



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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 99/01590

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 G01V1/38 B63B21/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01V B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 613 025 A (GECO AS) 31 August 1994 (1994-08-31)	1,11,12, 15,16,19
Y	page 2, column 1, line 1 - line 4 page 3, column 3, line 14 - line 23 page 3, column 3, line 44 - line 50 page 4, column 5, line 17 - line 35 page 4, column 6, line 38 - line 45; claims 1,10,11	6,9,17, 23
Y	US 4 676 183 A (CONBOY MICHAEL R) 30 June 1987 (1987-06-30) column 3, line 51 -column 4, line 2	6
Y	US 4 890 568 A (DOLENGOWSKI GEORGE A) 2 January 1990 (1990-01-02) column 1, line 5 - line 10 column 6, line 61 -column 7, line 3	9
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search

20 December 1999

Date of mailing of the international search report

12/01/2000

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Authorized officer

Lorne, B

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 99/01590

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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